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UNITED STATES ARMY ENVIRONMENTAL HYGIENE AGENCY

ABERDEEN PROVING GROUND, Mb **21010**

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GUIDE FOR THE MEDICAL SURVEILLANCE OF PEST CONTROLLERS

DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010

HSE-OO/WP Technical Guide (MED) March 1976

GUIDE -FOR THE MEDICAL SURVEILLANCE OF PEST CONTROLLERS

FOREWORD

This Guide concerns a medical surveillance problem that has given rise to numerous telephone calls and written inquiries from Health and Environment officers, occupational health physicians and nurses, and medical and engineer entomologists. As explained in the Introduction, this Guide is not a regulation, but intends to provide guidance for practical use. It is not meant for all times and for all places, and it will be updated and expanded as the need arises.

input from users is requested in the form of comments and suggestions for improvement. Direct comments to Commander, US Army Environmental Hygiene Agency, ATTN: Occupational Medicine Division, Aberdeen Proving Ground, MO 21010.

It is suggested that this Guide be filed together with the Medical Surveillance Guide, published by this Agency in January 1975.

CONTENTS

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SECTION I. GENERAL

1-1. INTRODUCTION.

a. This Guide is intended to assist the local medical authority ("Installation Surgeon" as defined in AR 420-76, Pest Control Service, 24 November 1971) in determining a program for the medical surveillance of personnel involved in the formulation and application of pesticides ("pest controllers"). Although not a regulation, the Guide adheres to general standards of good medical practice in that the recommendations contained herein are derived from reputable sources of information considered to represent the state-of-the-art at the time of writing. However, the Guide does not intend to interfere with the responsibility of the local medical authority, who may deviate from recommendations in the Guide when, in his/her considered opinion, there is a reason for doing so.

b. The increasing [redacted] of pesticides in the military community requires constant attention to avoid adverse effects in humans and in the environment or, at least, to limit these effects to a reasonable minimum. With respect to the potential hazards to individuals handling pesticides in large amounts, the role of the medical authorities is twofold:

(1) To insure, in cooperation with the Facility Engineer, that effective safety measures are taken, and that pest controllers are made aware of the potential hazards involved in the formulation and application of pesticides.

(2) To monitor, through a program of medical surveillance, the occurrence of signs and symptoms in pest controllers which represent hazardous effects from exposure to pesticides and, thus, are indicative of insufficient adherence to safety procedures.

c. This Guide provides information concerning the toxicity of the major pesticides presently in use by the Army, and formulates guidelines for the biological monitoring of pest controllers. Data sheets for each group of pharmacologically related pesticides are included. They contain information on signs and symptoms of poisoning, laboratory findings, and suggested treatment. Guidance regarding medical surveillance of pesticides which are adopted for standard use (Federal Supply Catalog Class 6840 Items), and not

covered by this Guide may be obtained from the US Army Environmental Hygiene Agency (USAEHA). Such requests should be submitted in writing through Commander, USA Health Services Command, ATTN: HSPA-H, Ft Sam Houston, TX 78234, to Commander, USAEHA, ATTN: HSE-00, Aberdeen Proving Ground, MD 21010. Prior to the approval of nonstandard items for pest control, guidance with respect to the health hazards from such items should be sought from USAEHA (ATTN: HSE-OO).

d. Some pesticides, although not frequently used in general, may be applied extensively at a few specialized facilities, and not always by certified pest controllers. Applications include fumigation of various commodities with substances such as aluminum phosphide and methyl bromide, or with such highly toxic agents as calcium or sodium cyanide, The methods generally in use mitigate against occupational health hazards. Because of the potential for exceptionally acute hazards, however, installation surgeons should be cognizant of the occurrence of these applications at their installations. If needed, guidance regarding medical surveillance and accident handling may be obtained from USAEHA as indicated in paraqraph c, above.

1-2. CONCEPTS AND DEFINITIONS.

a. "Toxicity" versus "Hazard".

(1) The *toxicity* of a substance such as a pesticide is determined according to a number of indices (such as oral and dermal LD_{50}), and based on tests carried out on laboratory animals (normally the rat).

(2) The *hazard* posed by a substance depends, in part, on the toxicity of that substance, but, most importantly, on the availability of the various routes by which the substance may be taken up in the body. In the case of pesticides, these routes are determined by the physical state of the compound that is used (powder, liquid, aerosol, etc.) and by the method of use or formulation (dry mixing, dilution, spraying, dusting, etc.).

(3) If good practices are followed, even the most toxic pesticides may be used safely, i.e., without creating a health hazard. Conversely, improper application techniques and procedures involving much less toxic pesticides may result in serious injury,

b. Individual Variability. There exist considerable *variations in sensitivity* among animal species; e.g., between rat and man, and among individuals within a species. The former factor necessitates caution in extrapolating toxicity data from experimental animals to man, and the latter in assuming that exposures considered harmless in most individuals are also completely safe in individuals such as children, asthmatics, etc. It should also be noted that *skin absorption*, an important route of entry in some

pesticides, varies widely with location: -e.g., the scrotal skin has been shown to allow a penetration 40 times higher than the ventral forearm. This phenomenon may be important in accidental cases where large surfaces of clothing are drenched with insecticides,

c. In the context of this Guide, the following *definitions* will apply:

(1) "Dermal LD_{50}" means a single dermal dose of a substance that is lethal to 50 percent of the test population of animals under test conditions as specified by the US Environmental Protection Agency (EPA).

(2) "Oral LD_{50}" means a single, orally administered dose of a substance that is lethal to 50 percent of the test population of animals under test conditions asspecified by the EPA.

(3) "Inhalation LC_{50}" means a concentration of a substance in air that is lethal to 50 percent of the test population of animals under test conditions as specified by the EPA,

(4) "Pesticide" means any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest, and any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant.* *Examples* of classes of pesticides are the following:

(a) Amphibian and reptile poisons and repellents.

(b) Bird poisons and repellents.

(c) Fungicides.

(d) Herbicides,

(e) Insecticides and insect repellents.

(f) Mammal poisons and repellents.

(g) Rodenticides.

(5) "Formulation" means the substance or mixture of substances comprised of all active and inert (if any) ingredients of a pesticide intended for distribution and use; or, the preparation of such a mixture of substances.

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* Prior to July 1975, the term "economic poison" was used instead of "pesticide",

1-3. REFERENCES. This Guide does not replace regulatory and legal requirements with respect to the proper use and control of pesticides. Listed below are some of the more important documents containing relevant provisions, with a summary of those parts that pertain directly to the control of pesticide hazards.

a. AR 40-5, Health and Environment, 25 September 1974.

(1) chapter 5, Section III - Medical Entomology and Pesticides. This Section assigns responsibility to the medical authority for providing technical guidance for the control of insects and animals affecting the health and morale of Army personnel (paragraph 5-22): gives provisions for the issuance of pesticides to untrained Army personnel, for the sale of such items by post exchanges and commissaries, for protective measures to be taken by personnel handling pesticides, for pesticide monitoring by USAEHA, and for disposal of pesticides and pesticide containers (paragraph 5-23); and describes the functions of the Armed Forces Pest Control Board (paragraph 5-24).

(2) Chapter 8, Section I - Command Health Report:: [RCS MED-3(R6)]. In this section, a requirement is listed for inclusion of the results of the insect and rodent control program in the Command Health Report [paragraph 8-7b(5)].

b. AR 420-76, Pest Control Services, 24 November 1971.

(1) Chapter 1 - General, states the responsibility of the installation surgeon for providing technical guidance for the safe application of toxic pesticides (paragraph 1-4d).

(2) Chapter 2 - Training, and Chapter 3 - Certification, contain requirements for the training, certification, and recertification of pest controllers, to ensure that control measures are applied with maximum safety, efficiency, and economy, in order to safeguard against accidental poisoning and to minimize contamination of the environment. The engineer entomologist is referred to as the person responsible for observing the pest controller's competency in the selection and use of correct control techniques, and the use of protective clothing,

(3) Chapter 6 - special Phases of Work, supplies requirements for the safe storage and formulation of pesticides, for the provision of protective devices, and for the reporting of pesticide spills to the installation surgeon.

(4) Chapter 8 - Detailed Instructions - DD Form 1532, and the Appendix, give extensive information on the monthly reporting of pest control activities by the use of DD Form 1532 - Pest Control Summary Report. This report is cosigned by the installation surgeon.

c. Federal Insecticide, Funqicide and Rodenticide Act. The Federal Insecticide, Fungicide and Rodenticide Act, as amended by the Federal Environmental Pesticide Controi Act of 1972 (Public Law 92-516, 86 Stat. 973), provides the authority for the issuance of the Federal Regulations discussed in paragraph 2d below.

a. Title 40, Code of Federal Regulations (CFR), 1975 ed., Part 162, Regulations for the Enforcement of the Federal Insecticide, Funqicide and Rodenticide Act (40 CFR 162).*

(1) This part provides extensive regulations for the registration and classification of pesticides; It requires that applicants for registration of a pesticide supply data concerning the *hazard to humans and domestic animals*, based on acute and chronic toxicity studies in experimental animals, and provide information as to the diagnosis and first aid of potential poisoning with the pesticide concerned (40 CFR 162.8).

(2) Title 40 CFR 162 also requires *labeling* of every pesticide product. The information on the label includes warnings and precautionary statements concerning the general areas of toxicological hazard. This information is determined by the toxicity category of the pesticide which is discussed below. Included on the label is a "statement of practical treatment", i.e., a description of first aid and other measures recommended in case of poisoning. Depending on the toxicity category is the presence of a specific "human hazard signal word", such as "Danger", "Warning", or "Caution". The significance of these signal words is also discussed below. Finally, a statement as to the use classification is included on the label, indicating whether the pesticide concerned is permitted for general use or for restricted use, i.e., for use by certified applicators only (40 CFR 162.10).

e. Public Health Service Publication No. 476. Public Health Service Publication No. 476: Clinical Handbook on Economic Poisons - Emergency Information for Treating Poisoning, W. J. Hayes, Jr., US Government Printing Office, Washington, DC 20402. This handbook supplies extensive information an the toxicology of pesticides, and the symptomatology and therapy of pesticide poisoning. Most of the medical information in this Guide is derived from this handbook, and has been updated where necessary by more recent information.

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* As amended by 40 Federal Register (F.R.) 28267, et seq, 3 July 1975; CFR edition of 1976 will have the revised text.

SECTION II. HEALTH HAZARDS OF PESTICIDES

2-1. EXPOSURE TO AND PROTECTION FROM PESTICIDE HAZARDS.

a. Types of Exposure. Pest controllers may be exposed to pesticides and certain solvents in a variety of ways.

(1) *Dermal exposures* occur especially in outdoor spray applications and in applications involving dusts and granules. The preparation of diluted formulations from stock concentrates may also result in considerable dermal exposure if a spill occurs.

(2) *Respiratory exposures* from outdoor spraying are usually much less serious than dermal exposures, except to children, asthmatics, emphysema patients, and other individuals with unusually high sensitivity. The main applications and formulations responsible for potential respiratory exposures are those mentioned above.

(3) *Internal exposure* by ingestion is not normally a significant hazard to pest controllers, but may occur in children, particularly from bait pesticides, mothballs and rodenticides used in indoor treated areas.

b. Types of Protection. Protection against pesticide exposure is obtained in two ways: by measures aimed at containment or limitation of pesticide spread (collective protection), and by measures which provide a personal barrier against pesticides (personal protection).

(1) Collective protection is particularly important for the activities performed in pest control shops, such as dilution and mixing of pesticides. Measures include those pertaining to fire prevention, ventilation, plumbing, and personnel change and bathing facilities. In the case of formulations involving powders and concentrated solutions, local exhaust ventilation is the method of choice for the prevention of airborne contamination.†

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† USAEHA Entomological Special Study No. 99-045-75/76, Criteria for Design of a Pest Control Shop, Pesticide Storage and Mixing Facility, gives guidance for these safety features. This special study is attached as Appendix A.

(2) Personal protection includes organic vapor respirators and protective clothing. Full-face masks are only required in spray application of highly toxic pesticides; in most other sprayings, a half-face respirator suffices. Protective clothing usually consists of special work clothing which is issued clean daily. Impermeable pieces of clothing, such as rubber aprons, are usually only necessary in handling highly toxic pesticides.

2-2. TOXICITY CLASSIFICATION.

a. Each pesticide, upon registration by EPA, is assigned a *toxicity category* which indicates the degree of toxicity as determined by animal experimentation and from experience in humans (if any). The classification recognizes four categories (I-IV) for each of five "hazard indicators": The oral LD_{50}, the inhalation LC_{50}, the dermal LD_{50}, eye effects, and skin effects. It is important to note that a pesticide may be highly toxic for one hazard indicator (e.g., the oral LD_{50}), and only slightly toxic for others (e.g., the dermal LD_{50}, and skin effects). The official registration category, however, is determined *by* the hazard indicator which is related to the highest degree of toxicity. The table (derived from reference paragraph 1-3d) summarizes the classification criteria.

b. EPA provisions for *labeling* of *pesticide products* require the use of "human hazard signal words" on the label to indicate the potential hazard. For highly toxic pesticides (Category I), the word DANGER is used. If this toxicity category is based on the oral, dermal, or inhalation LD_{50}, the product concerned will also be labeled POISON (in red on a contrasting background), together with the familiar skull-and-crossbones symbol. Category II pesticides (moderately toxic) are labeled WARNING, whereas both Categories III and IV pesticides are labeled CAUTION. All pesticides (with few exceptions) are also labeled "Keep out of reach of children,"

c. The toxicity classification and labeling, as described, apply primarily to products on the basis of their acute *toxicity*. If a pesticide causes significant chronic toxic effects in man (such as cancer induction, mutagenic and teratogenic effects), it is also subject to a "restricted use classification", which will not be discussed here. As in the case of acutely toxic pesticides, the label will supply relevant information to determine the need for medical surveillance.

TABLE
TOXICITY CATEGORIES AND HAZARD INDICATORS OF PESTICIDES

Toxicity Category		Hazard Indicators					Signal Word (On label)
No.	Description	Oral LD_{50} (mg/kg)	Inhal. LC_{50} (mg/l)	Dermal LD_{50} (mg/kg)	Eye Effects	Skin Effects	
I	highly toxic	<50	<0.2	<200	Corrosive; cornea1 opacity not reversible within 7 days	Corrosive	DANGER POISON (only if Cat. I for any of first three hazard indicators.
II	moderately toxic	50-500	0.2-2	200-2,000	Cornea1 opacity reversible within 7 days; irritation persisting for 7 days	Severe irritation at 72 hrs	WARNING
III	slightly toxic	500-5,000	2-20	2,000-20,000	No cornea1 opacity; irritation reversible within 7 days	Moderate irritation at 72 hrs	CAUTION
IV	*practically non toxic*	>5,000	>20	'20,000	No irritation	Mild or slight irritation at 72 hours	CAUTION

NOTE : Numbers listed apply to the pure substance only; dilutions may have a considerably lower toxicity.

?-3. PHARMACOLOGY OF PESTICIDES AND SOLVENTS.

a. On the basis of their mode of action, pesticides may be grouped in the following classes:

(1) Cholinesterase inhibiting substances.

(2) Chlorinated hydrocarbons.

(3) Miscellaneous other pesticides.

Most of the insecticides in present use belong to classes (1) and (2). Class (3) includes a few herbicides and rodenticides with different modes of action. A listing of the pesticides most frequently used at Army installations is contained in Appendix A.

b. Cholinesterase Inhibiting Substances (CIS).

(1) All of the substances in this group are used as insecticides, usually in the form of sprays or dusts. The toxicity of these insecticides varies widely, depending on their absorption and excretion characteristics, and on their action after absorption. Their main effect is inhibition of the enzyme cholinesterase in various tissues, resulting in the accumulation of acetylcholine. Clinical symptoms depend on the degree of cholinesterase depression, the rate at which it occurs, the tissues primarily affected, and the rate of recovery of the cholinesterase depression. In this respect, there is a marked difference between the two subgroups of CIS: the organophosphorus compounds (OP), and the methylcarbamates (MC). Substances in the latter subgroup inhibit cholinesterase, but the reversal of the inhibition is so rapid that measurements of blood cholinesterase are nearly always normal, sometimes even in patients with manifest signs of MC poisoning. Conversely, some of the OP compounds may, especially in the case of repeated small exposures, result in low blood cholinesterase levels without manifest clinical disease.

(2) Usual symptoms of acute CIS intoxication include headache, giddiness, nervousness, blurred vision, weakness, nausea, cramps, diarrhea and chest tightness. Signs may include sweating, miosis, tearing, salivation, excessive respiratory tract secretion, vomiting, cyanosis, papilledema, uncontrollable muscle twitches which may develop into convulsions, coma, loss of reflexes and loss of sphincter control.

(3) Signs and symptoms are highly dose dependent. In practice, only large doses of the more toxic CIS pesticides, associated with suicide attempts or with gross abuse of these pesticides, may result in serious, life threatening conditions. In occupational cases, relatively incapacitating symptoms such as nausea, cramps, discomfort in the chest, etc., may occur as sequelae of the initial giddiness, blurred vision, and headache.

(4) More specific information, related to particular compounds, is contained in Appendix C.

c. Chlorinated Hydrocarbons (CHC). This group of pesticides (mostly insecticides) shows wide variations in chemical structure and activity. The substances in this group are notorious for their low biodegradability in nature, and for their accumulation In fat tissue. Typical examples are DDT, lindane, dieldrin, endrin and chlordane, of which only the last is used extensively for termite control. Most CHC act on the central nervous system, resulting in excitation and convulsions at high doses. Nausea and vomiting may also occur. Chronic exposure to CHC results in accumulation in fatty tissues, and microscopic changes in liver and kidneys have been demonstrated in experimental animals. It should be noted that many of the symptoms are nonspecific and may also be caused by the solvent rather then by the CHC compound itself (see paragraph e, below, for a discussion of solvent effects).

d. Miscellaneous Pesticides. This group contains a number of pesticides frequently used at Army installations (cf. Appendix B). The group consists primarily of a number of rodenticides (usually used as finished baits), herbicides, and biological insecticides, which have no common pharmacological action.

(1) *Anticoagulant Rodenticides.* These rodenticides are applied as baits, which are either supplied in prepared form, or as a solution for the preparation of baits. The active ingredient is a derivative of coumarin, such as *warfarin* or *fumarin*, or derived from 1,3-indandione, such as *pival* or *diphacinone*. All of these compounds have a similar mode of action and are highly toxic in pure form, but their availability in the supplied baits or solutions is restricted by their extremely low concentration (0.005 to 0.025 percent in prepared baits, 0.05 to 0.5 percent in "concentrate"). As a consequence, only gross misuse *or* suicide attempts may result in serious intoxication. See Appendix C for further information on anticoagulant rodenticides.

(2) *Herbicides* most frequently used are those in the group of the chlorophenoxy-compounds (typical examples: 2,4-D, and 2,4,5-T). These substances are moderately toxic in their pure or technical grades, and are used at low concentrations in a variety of solvents. Significant occupational exposure is rare. See Appendix C for further information on these compounds and other herbicides in Army use.

(3) *Biological insecticides* are *the* active ingredients of pyrethrum extract (pyrethrins) or a synthetic analogue (allethrin). The most commonly used formulation is a 0.4 to 0.6 percent solution for spraying purposes, but higher concentrations in solvent extracts, powders, and emulsifiable preparations are used commonly. Pyrethrins are among the least hazardous

insecticides. Health effects, if occurring, are usually limited to the skin, possibly caused by- sensitization. Typical skin lesions include a mild dermatitis with vesicles and papules, and *intense* pruritus. Systemic uptake is extremely rare.

e. Solvents. Many pesticides are applied in low-concentration solutions in a suitable solvent, most commonly kerosene or *xylene*. As a consequence, the amounts of these solvents that pest controllers may be exposed to are far larger then those of the component pesticide, and toxic effects observed may well be caused by the solvent rather than by the pesticide.

(1) *Kerosene*, or coal oil, may be present in concentrations of up to 98 percent in sprays. As the solvent is usually highly refined it is essentially odorless. Route of absorption is primarily oral or by inhalation; dermal penetration is insignificant, although it may act as a local irritant. Effects of absorption are the result of its depressive action on the central nervous system, sometimes preceded by an excitement phase. Liver and kidney damage may occur in severe cases. Inhalation may produce a pneumonitis, but more *commonly* results in symptoms such as fullness of the head, headache, blurred vision, dizziness, unsteady gait, and nausea.

(2) *Xylene* is also a common solvent in many insecticide solutions. It is absorbed by both the oral and respiratory routes; dermal absorption is insignificant. More so than kerosene, it is a severe irritant to mucous membranes and skin. Signs of poisoning are not unlike those of kerosene, with more severe effects of mucous membrane irritation. Commercial grades of xylene may be contaminated appreciably by *benzene*, which may affect the hematopoietic system.

SECTION III. MEDICAL SURVEILLANCE OF PEST CONTROLLERS

3-1. GENERAL CONSIDERATIONS.

a. The *extent of a medical surveillance program* for pest controllers is determined by a number of factors:

(1) The number, amount, and toxicity of the pesticides being handled.

(2) The potential hazards connected with the formulations and applications being performed.

(3) The presence or absence of a well ventilated, properly designed and constructed pesticide shop (see Appendix A for guidance).

(4) The degree of adherence to procedures intended to minimize pesticide health hazards.

(5) The extent of, and the results obtained with, a workplace environmental survey program for determining personnel exposures.

b. Depending on the result of a *health hazard evaluation,* i.e., the evaluation of the importance of each of the factors listed above, a choice may be made between the establishment of a restricted, "basic", medical surveillance program, or that of a more extended program. Features of a basic and those of an extended program will be given in paragraphs 3-2 and 3-3 below.

c. The fact that the exposure of pesticide *workers,* as a rule, is not restricted to one particular substance, but to a number of pesticides and solvents with very different modes of action and *degrees* of toxicity, necessitates *a comprehensive system of medical surveillance.* This system should include "monitoring" of different organ systems, rather than checks on the behavior of one particular parameter, such as the red-blood-cell cholinesterase activity.

d. The medical management of *accidental ingestions* is not explicitly covered in this Guide. However, useful information to assist the local medical authority is contained in Appendix C. Professional guidance for the handling of poisonings not covered in this Appendix may be obtained from local poison control centers or from USAEHA, Division of Occupational Medicine, AUTOVON 584-2745 or -3534 (Commercial lines 301-671-2745 or -3534).

e. At present (March 1976), more than 50 pesticides are included in the list of "Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1975", published by the

American Conference of Governmental Industrial Hygienists. Many of these are also included in the Occupational Safety and Health Act (OSHA) standards list for air contaminants (Title 29, CFR, 1975 ed., Part 1910, Occupational Safety and Health Standards - Table z-l). In the near future, the OSHA listing will be converted to a set of "mini-standards", i.e., a series of regulations that will also include requirements for the medical surveillance of workers exposed to the substances listed in the standards. Wherever there is a conflict between the requirements given by OSHA and the reconnnendations in this Guide, the more stringent requirements will prevail. As soon as the mini-standards are completed, a revision of this Guide will be published in which regulatory requirements are incorporated.

3-2. THE BASIC MEDICAL SURVEILLANCE PROGRAM.

a. This program intends to cover workers for which all, or practically all, factors mentioned in paragraph la of this Section are favorable. Specifically, no highly toxic (Category I) pesticides are being used; quantities handled are relatively small; there is a well equipped pesticide shop with excellent provisions for the prevention of contaminations: and strict procedures are in force regarding the safe use of pesticides. Thus, there is very little chance that significant exposure to pesticides will take place. In such a case, medical surveillance is primarily instituted to insure (periodically) that workers are fit for their job as pest controllers, and that there are no physical conditions which would make them more vulnerable to pesticide health hazards.

b. The basic program includes preplacement, periodic, and pretermination medical examinations with emphasis on general health, and the cardiovascular, respiratory, hepatic and renal systems.

(1) The preplacement examination should include a medical and work history, a physician-administered physical examination with particular attention to the cardiovascular and respiratory systems to evaluate the employee's ability to use respiratory protective equipment, an examination of the hepatic and renal systems to insure that employees will not be unusually susceptible to ill effects from pesticides or solvents, a chest x-ray, spirometry with determination of forced vital capacity (FVC) and forced expiratory volume at one second (FEV-1), a complete blood. count, liver function tests such as serum glutamic walacetic transaminase (SGOT) and lactic dehydrogenase (LDH), and renal function tests such as creatinine or blood urea nitrogen (BUN). The preplacement examination should also include the determination of a baseline cholinesterase value in red blood cells and in plasma, defined as the average value of three separate measurements obtained during a 9- to 14-day period. In subsequent examinations, one cholinesterase measurement (in red blood cells only) suffices. All cholinesterase determinations shall be performed in accordance with TB MED 292, Determination of Cholinesterase Activity: Manual and Automated Methods, 30 May 1975,

(2) A periodic examination of the same scope-as the preplacement examination should be given on an age-related basis according to the following schedule:

under 40 years:	every 4 years
between 40 and 49 years:	every 2 years
50 years and over:	annually

In addition, the liver and kidney function tests, the complete blood count, and the red blood cell cholinesterase measurement should be performed annually regardless of age. If other occupational exposures exist, such as high noise levels from vehicles or aircraft used for spraying, appropriate medical surveillance (audiograms in this instance) should also be provided.

c. The results of the periodic examinations are expected to be negative. If it appears that deviations from normal occur for occupationally related reasons, more frequent or extensive examinations may be indicated. At the same time, an investigation into the existence of unfavorable working conditions or habits must be started.

d. The pretermination examination has the same scope as the periodic examination. It is important that any abnormal findings that may be ascribed to pesticide exposure be further investigated and documented.

3-3. THE EXTENDED MEDICAL SURVEILLANCE PROGRAM.

a. The need for a more extensive program arises in situations in which Category I pesticides are used, in cases where medical examinations have indicated a need for more frequent monitoring, and when a health hazard evaluation indicates potential pesticide exposures that may result in manifest health effects. If the extended program is instigated for reasons of potentially or actually unfavorable working conditions, it should be considered an interim measure until more effective engineering controls are installed.

b. The extended surveillance program should, basically, include all elements described in paragraph 2b of this Section. In addition, more frequent periodic checks are desirable. These checks consist of an inquiry into the occurrence of symptoms, indicative of pesticide exposure, and a number of laboratory tests.

(1) A short medical history should be obtained by the occupational health nurse, covering the following items:

GEN : fever, weight change, weakness, fatigability, sweating, sleep patterns, skin disorders, allergy.

GI : nausea, vomiting, appetite, taste, gas, pain, stools, excessive salivation.

NM : headache, dizziness, irritability, paresthesia, pains, twitching, tremors, fasciculations.

CR : nasal discharge, wheeze, cough, expectoration, pain, tightness in the chest, dyspnea, palpitation, heart consciousness, fainting, tachycardia.

GU : urination.

EYE: miosis, acuity, double vision, tearing, perception of brightness.

PSY: temperament, judgment, affect, memory, nervousness, drowsiness, insomnia.

(2) Laboratory tests shall include, as a minumum, those that provide information on liver and kidney function, cholinesterase activity (see paragraph c below), and blood cell counts (CBC).

The frequency of these checks depends *on* the actual working conditions, the amounts and toxicities of pesticides handled, etc. If no Category I (highly toxic) pesticides *are* in use, a quarterly frequency would appear to be indicated. Activities involving highly toxic pesticides would necessitate a monthly frequency, unless there is an active, well-managed program directed towards prevention of personnel exposures, in which case a quarterly frequency may be considered sufficient.

c. Since significant depressions of cholinesterase in red blood cells, in practice, only occur in case of exposure to highly toxic OP, there is little reason to include the measurement of the activity of this enzyme as part of the quarterly checks. Such measurements may be deemed necessary, in all or in particular pest controllers, in case large quantities of highly toxic OP are being used, and especially in case of extensive spraying activities with such OP.

3-4. ACTION LEVELS FOR REMOVAL FROM, AND RETURN TO, WORK.

a. In general, any abnormal finding that may be related to pesticide exposure should result in removal from further exposure until a complete evaluation *has* been made with respect to the extent, cause, and significance of the finding. Return to work should not be recommended, irrespective of whether the abnormality is caused by pesticide exposure or not, if such exposure may cause further detriment to the health of the worker.

b. In the case of red blood cell cholinesterase (RBC ChE) depressions, which are practically always fully reversible (given sufficient time of nonexposure), the following practice should be adopted:

(1) Removal from work shall be instituted when the RBC ChE activity is depressed to 75 percent of the baseline value or less.

(2) Return to work is permitted when the RBC ChE activity has returned to 80 percent or more, provided that this level has been confirmed by a second test, and provided that the worker concerned has had no exposure to OP or MC for at least 1 week.

C. As the normal recovery rate of RBC ChE is approximately 1 percent per day, there is little basis for a more frequent ChE determination after removal from work than weekly. It is recommended that the health records show the RBC ChE results both in absolute units and as a percentage of the baseline value.

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CRITERIA FOR DESIGN OF A PEST CONTROL SHOP
PESTICIDE STORAGE AND MIXING FACILITY
MARCH- JULY 1975

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Criteria for design of a Pest Control Shop Pesticide Storage and Mixing Facility are presented. Inclosed are guidelines for site selection, special construction and equipment requirements, and recommended safety features.

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DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010

HSE-RE/WP

ENTOMOLOGICAL SPECIAL STUDY NO. 99-045-75/76
CRITERIA FOR DESIGN OF A PEST CONTROL SHOP
PESTICIDE STORAGE AND MIXING FACILITY
MARCH- JULY 1975

ABSTRACT

Criteria for design of a Pest Control Shop Pesticide Storage and Mixing Facility are presented. Inclosed are guidelines for site selection, special construction and equipment requirements, and recommended safety features.

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MARCH - JULY 1975

1. **REFERENCES.**

a. **AR 420-76, Pest Control Services, November 1971.**

b. **AR 200-1, Environmental Protection and Enhancement, 7 December 1973.**

C. **Letter, AMCIS-RI, USAMC Installations and Services Agency, Rock Island, Illinois, 6 March 1975, subject: Criteria for Design of a Pesticide Storage and Mixing Facility.**

d. **US Environmental Protection Agency, 40 Code of Federal Regulations 165, Regulations for the Acceptance of Certain Pesticides and Recommended Procedures for the Disposal and Storage of Pesticides and Pesticides Containers, Federal Register, 39(85):15236, May 1, 1974.**

2. **GENERAL.**

a. **The following criteria and procedures are recommended for the design of a pest control shop, pesticide storage, and mixing facility.**

b. **These criteria are not intended to be specific or inclusive for all pest control shops due to the impracticality of establishing a single design which would not allow for required variation from one pest control shop operation to another.**

C. **Where relevant, the criteria presented should be adhered to-**

3. **PESTICIDE STORAGE SITES.**

a. **Sites should be selected with due regard to the amount, toxicity, and environmental hazard of the pesticides to be used, the number and sizes of containers to be handled, and the number and types of equipment required.**

b. **Sites should be located where flooding would present the least risk and where soil texture/structure and geologic/hydrologic characteristics will prevent the contamination of any water system by runoff or percolation.**

c. **Where warranted, drainage from the site should be contained (by natural or artificial barriers or dikes), monitored, and, if contaminated, properly disposed.**

d. Requests for assistance in selection of specific sites, monitoring or disposal requirements may be directed to the Commander, US Army Environmental Hygiene Agency; ATTN: HSE-RE, Aberdeen Proving Ground, Maryland 21010. Requests should be addressed through command channels to Commander, USA Health Services Command, ATTN: HSPA-H, Fort Sam Houston, Texas 78234.

4. **STORAGE FACILITIES.**

a. Pesticides should be stored in a dry room or building where fire protection is provided and where temperatures above 40°F and below 100°F are maintained. Storage should be separate from mixing room, change rooms, offices, or any area where personnel work for prolonged periods.

b. The floor of the pesticide storage facility must be a concrete slab having a continuous curb at least 4 inches high. The thickness of the slab will depend on floor loading or existing standards. Floor drains are prohibited.

C. Ventilation.

(1) A tempered air ventilation system should be installed which provides at least 10 fresh air changes per hour. Heating and/or cooling systems should be designed to supply 100 percent outdoor air and should not be recirculated.

(2) In the interest of conserving energy required for heating, cooling, and exhaust ventilation, room sizes of storage facilities should be kept to a minimum.

(3) Where work areas are adjacent to storage areas and interfacing doors exist, the storage area must have a negative pressure with respect to adjacent areas.

d. Standards for fire prevention and protection should be obtained from the local installation safety/fire officiale. Suggested areas to be considered are:

(1) Requirements for spark-proof motors and lighting fixtures.

(2) Fire resistant construction,

(3) Two exit doors greater than 28 inches wide with self-closing devices and side hinges.

(4) Placement of fire extinguisher systems.

e. Where relevant, the following precautions should be taken:

(1) The entire storage facility should be secured by a climb-proof fence, and doors and gates should be kept locked to prevent unauthorized entry.

(2) All items of movable equipment used for handling pesticides at the storage site which might be used for other purposes should be labelled "contaminated with pesticides" and should not be removed from the site unless thoroughly decontaminated.

f. Provision should be made for decontamination of personnel and equipment such as delivery trucks, tarpaulin covers, etc. A wash basin and shower with a delayed-shutoff pull chain valveshould be provided. In addition, the facility should be equipped with an eye lavage for irrigation of the eyes in case of accidental splash or spill. When required, the decontamination area should be paved or lined with impervious materials and should include gutters. Contaminated runoff should be collected and properly disposed.

g. Storage facilities which are remote from mixing areas and/or locker rooms should have a place to hang prepositioned personal protective clothing such as gloves, aprons, and eye goggles.

h. All entrances to the facility should be posted, warning that the facility should be ventilated, or that approved air-line or self-contained respiratory protective devices should be used, unless it is known that pesticide concentrations do not exceed 100 times the permissible time-weighted average concentration of the most toxic material present for respirators, and 1000 times the concentration for gas masks.

5. PESTICIDE MIXING FACILITY.

a. Pesticides should be mixed in a dry, separate room, building, or covered area where fire protection is provided.

b. Floor drains are prohibited.

c. The mixing facility should be designed using the principles of local exhaust ventilation. The objectives of local exhaust ventilation are to contain, capture, and exhaust vapors (i.e., pesticide and solvent vapors). To do so, a hood should be designed to enclose the mixing operation as much as possible and to exhaust the vapors away from mixing personnel. USAEHA Plate 38 (Appendix) provides guidance on two acceptable methods. Where a sink is used for mixing, a hood that encloses the sink on both sides and exhausts from the rear or top should be utilized. At least 2 linear feet of bench space should be next to the sink and should be ventilated at the same hood that exhausts the sink. A face velocity (air velocity at the hood opening) of 150 linear feet per minute (lfpm) is necessary to capture the contaminated air at that

point and properly exhaust it. Baffles or plenums should be used to maintain a uniform face velocity (150 lfpm ± 20 percent variation) at the hood opening, A bypass sash or door between the worker and the material being mixed may be used to restrict the size of the hood opening and further protect the worker. Where work areas are adjacent to mixing facilities and interfacing doors exist, the mixing facility should have a negative pressure with respect to adjacent areas. Further guidance on hood design can be obtained from "Industrial Ventilation", 13th Edition, published by the American Conference of Governmental Industrial Hygienists, P.O. Box 453, Lansing, Michigan.

d. Plumbing requirements in the pesticide mixing facility:

(1) Provide a source of running water.

(2) Install a sink of sufficient size to acconnnodate the diameter of a S-gallon pesticide container. A 2- by 2- by 2-ft sink is recommended, The sink discharge is routed to the sanitary sewer.

(3) Install a sign over the sink which reads: DO NOT DISCHARGE PESTICIDE OR PESTICIDE SOLUTION INTO THE SINK.

(4) The water faucet supplying water to the sink should be installed such that an air-gap of at least two diameters of discharge opening exists between the outlet of the faucet and the rim of the sink. A reduced pressure back-flow prevention device meeting American Water Works Association (AWWA) Standard C506-69 must be installed in line with the permanent plumbing. For installations which do not produce their own potable water, the anti-siphon device should be installed in conformance with local plumbing standards since some communities may prohibit the use of such devices at pesticide mixing facilities.

(5) Plumbing which provides a source of water for filling power-driven spray equipment tanks must be provided with either of the following:

(a) Permanent plumbing which will allows the spray tank to be positioned beneath the extending spigot. The spigot should be installed such that an air-gap or space exists between the discharge orifice of the faucet and the filling port on the spray tank; or

(b) A reduced pressure back-flow prevention device, meeting AWWA Standard C506-69, in line with the permanent plumbing. with this back-flow prevention device installed, a water hose can be attached to a faucet and can be used to fill the spray tank.

e. A drying and storage rack should be provided for small pesticide sprayers.

f. Standards for fire prevention and protection should be obtained from the local installation safety/fire officials, Suggested areas to be considered are:

(1) Requirements for spark-proof motors and lighting fixtures.

(2) Fire resistant construction.

(3) Two exit doors greater than 28 inches wide with self-closing devices and side hinges.

(4) Placement of fire extinguisher systems.

g. Provisions should be made for decontamination of personnel and personal protective equipment. A wash basin and a shower with a delayed-shutoff pull chain valve should be provided, In addition, the mixing area should be equipped with an eye lavage for irrigation of the eyes in case of accidental splash or spill. A soap dispenser (either liquid or flake) and paper towel dispenser should be installed near the sink.

h. A safety sign should be posted at the mixing area requiring the use of protective gloves, aprons and boots, protective eyewear and face shields, coveralls , and an approved pesticide respirator where hood ventilation rates are inadequate.

6. MISCELLANEOUS REQUIREMENTS.

a. A locker room must be provided with an area to remove contaminated clothing and a separate area to change into clean clothes.

b. A shower for use at the end of the work day must be provided.

C. It is recommended that 50 foot-candle illumination intensity at shelf level be provided in the pesticide storage and mixing area.

d. Toilets - one per 15 employees is required.

e. Stairways should be equipped with slip-resistant treads and nosings should have a nonslip finish. Provide railings *on* the open sides of all exposed stairways and stair platform.

f. A washer and dryer should be provided for laundering protective coveralls.

g. All offices and eating areas should be designed in such a manner which would preclude contamination by pesticide vapors.

h. Facilities should be provided for proper storage of protective equipment, particularly respirators. Consideration should be given to the fact that protective equipment is potentially contaminated.

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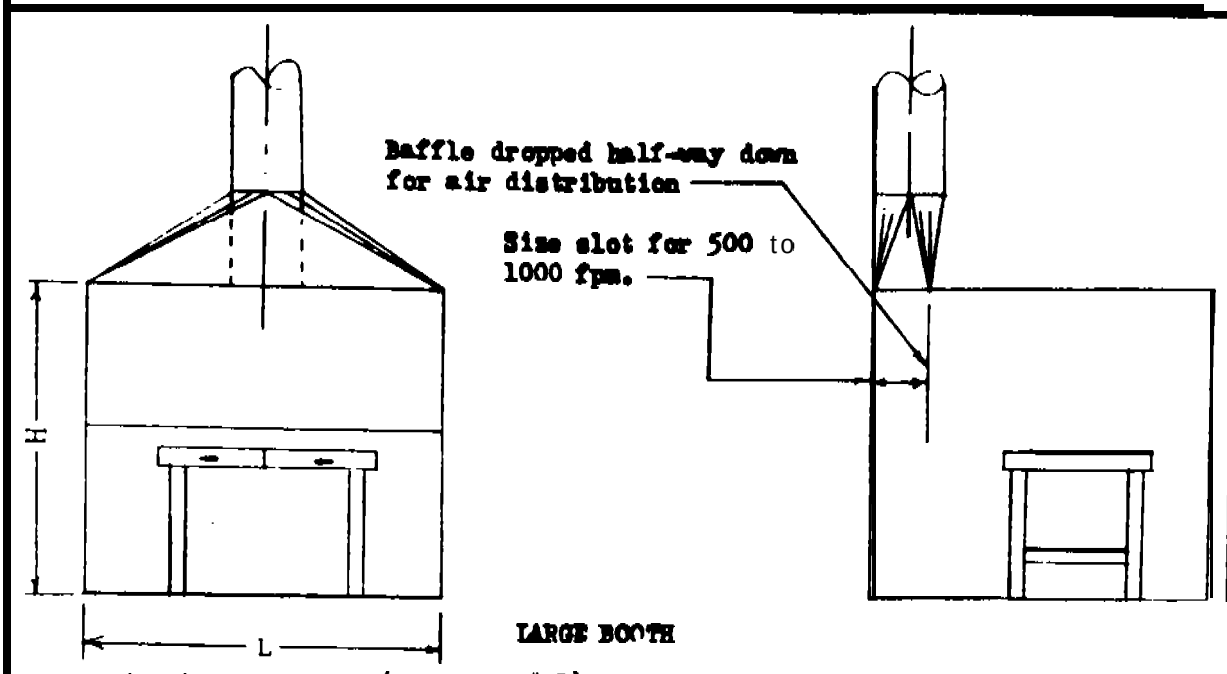
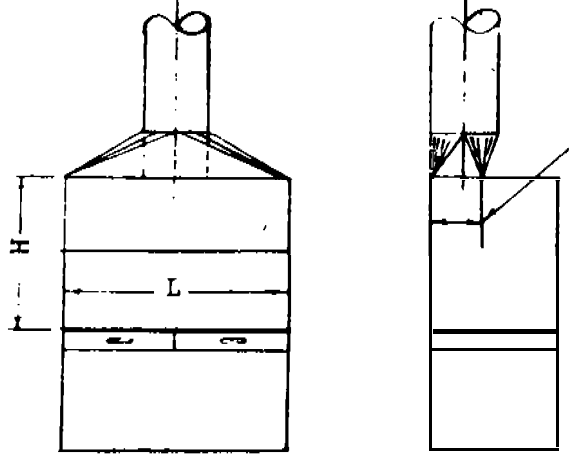
APPENDIX



LARGE BOOTH

Q(CFM)= V x HL (see note # 2)
Duct velocity (FPM) -2000
Entry loss = 0.50 duct VP (depending upon transition angle) + 1.78 Slot VP



SMALL BENCH TYPE BOOTH
Q(CFM)= V ' x HL (see note #2)
Duct velocity (FPM) = 2000
Entry loss = 0.25 - 0.50 Duct VP + 1.78 Slot VP

NOTE: 1) Reference: ANS Fundamentals Governing The Design and Operation of Local Exhaust Systems, ANSI Z9.2-1960.

2) ANS for Ventilation and Operation of Open-Surface Tanks, ANSI 29.1-1971 Table #3 for V value.

TABLE EXHAUST BOOTH

DATE 1 JUL 73
DRAWN DJL
APPROVED [illegible]
SCALE [illegible]
PLATE 38

U.S. ARMY ENVIRONMENTAL HYGIENE AGENCY
UNITED STATES ARMY MEDICAL DEPARTMENT

APPENDIX B

PESTICIDES MOST FREQUENTLY USED AT ARMY INSTALLATIONS

Class*	Common Name	Formulation	NSN	Use Classification	Other Designations
CIS (OP)	Malathion	57% emulsifiable concentrate, Grade A, 1-gal CM	6840-00-655-9222	Insecticide	Compound 4049, carbophos, Cythion®
		57% emulsifiable concentrate, Grade 8, 55-gal drum	6840-00-685-5437		
		57% emulsifiable concentrate, Grade A, 5-gal pail	6840-00-685-5438		
		95% solution concentrate, 55-gal drum	6840-00-926-1481		
	Diazinon	2% dust, 25-lb pail	6840-00-753-5038	do	Spectracide®, Basudin®
		0.5% solution, 1-gal can	6840-00-844-7355		
		48% emulsifiable concentrate, l-gal can	6840-00-782-3925		
	Naled	85% solution concentrate, 15-gal drum	6840-00-926-9163	do	Dibrom®
	Chlorpyrifos	40.8% emulsifiable concentrate	6840-00-402-5411	do	Dowco 179, Dursban®, Lorsban®, OMS 971
CIS (MC)	Propoxur	1% solution, i-gal CM	6840-00-180-6069	Insecticide	Baygon®, Bay 39007, Bay 9010, Blattanex®, Unden®, aprocarb
		2% bait, 5-lb bottle	6840-00-498-4057		
	Carbaryl	80% powder, 15-lb pail	6840-00-180-6141	do	Sevin®, carpolin, OMS 23
CHC	Chlordane	72% emulsifiable concentrate, 5-gal pail	6840-00-270-8262	Insecticide	Ortho-Klor®, Octachlor®
		5%-6%, dust, IS-lb pail	6840-00-543-7825		
Misc	See sec. II para 2-3, subpara d (1)	Rodenticidal Bait, Anticoagulant, 5-lb CM	6840-00-753-4973	Rodenticide	See text.
		Rodenticidal Bait, Anticoagulant, 40-block ctn	6840-00-089-4664	do	
		Rodenticide, Anticoagulant, l-lb CM	6840-00-753-4792	do	
Misc	Pyrethrin	0.68 aerosol, 12 oz can	6840-00-823-7849	Insecticide	
		0.4% solution, 1-gal can	6840-00-400-2140		
Misc	2,4-D	Low volatile ester, 4 lb/gal, 5-gal can	6840-00-577-4194	Herbicide	Aqua-Kleen 23, Emulsamine®, Esteron®, Formula 40®, Weedar® 64, Weedone®
		Amine, 4lb/gal, 5-gal can	6840-00-664-7060		
	Bromacil	80% powder, 50-lb drum	6840-00-890-2146	Herbicide	Hyvar®, Krovar®, Urabor®, Borocil®, Hibor
		Borate-Bromacil mixture, 50-lb can	6840-00-027-6467		

* CIS: cholinesterase inhibiting substances
OP: organophosphorus compounds
MC: methylcarbamates
CHC: chlorinated hydrocarbons

® Use of trademarked names does not imply endorsement by the US Army, but is used only to assist in identification of specific products.

APPENDIX C

DATA SHEETS ON INDIVIDUAL PESTICIDES

Data Sheet No.	Name
1.1	Malathion
1.2	Diazinon
1.3	Naled
1.4	Chlorpyrifos
1.5	Propoxur
1.6	Carbaryl
2.1	Chlordane
3.1	Anticoagulants
3.2	Pyrethrin
3.3	2,4-D
3.4	Bromacil

Data Sheet No. 1.1

Organophosphate **MALATHION**

Identity: 0,0-dimethyl S-(1,2-dicarbethoxyethyl) phosphorodithioate

Formulations: Wettable powder (25%), dusts, solutions, poison baits, emulsifiable concentrates.

Use Data: Insecticide; plant and fruit pests, houseflies, mosquitoes, lice.

Toxicity: Oral: III (slightly toxic)
Dermal: III (slightly toxic)

Toxicology: Inhalation and ingestion main routes of absorption; skin absorption inefficient. Reported signs and symptoms: headache, nervousness, blurred vision, weakness, nausea, *cramps*, diarrhea, chest discomfort, sweating, miosis, tearing, salivation, excessive secretions, vomiting, cyanosis, papilledema, muscle twitching, convulsions, coma. sudden coma with marked flaccidity of the limbs and without cardiovascular collapse or respiratory interference may occur.

Clinical Chemistry: Cholinesterase depression may be less than the clinical severity would predict.

Treatment: Atropine sulfate l-2 mg i.m. If excessive secretions occur, atropine hourly to 25-50 mg in a day. Keep patient atropinized. Decontaminate skin, stomach (induce vomiting) and eyes. 2-PAM*, slowly i.v. if patient fails to respond (1 g for adults, 0.25 g for infants). In severe cases, suction of trachea secretions and artificial respiration; oxygen; atropine 2-4 mg i.v. as soon as cyanosis has subsided; repeat at 5-10 minute intervals until signs of atropinization occur; 2-PAM* i.v. slowly. *Contraindicated* are morphine, theophylline, aminophylline; atropine in cyanotic patient; caution with tranquillizers.

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* pralidoxime, Protopam®, pyridine-2-aldoxime methbchloride

Data Sheet No. 1.2

Organophosphate

DIAZINON

Identity: 0,0-diethyl O-(2-isopropyl-4-methyl-6-pyrimidinyl)-phosphorothioate.

Formulations: 25% wettable powder, 2-4% dust, 25% emulsifiable concentrate, 20% solution, and poison bait.

Use Rata: Insecticide: fly and roach control, fruit and vegetable pests.

Toxicity: Oral: II (moderately toxic)
Dermal: II (moderately toxic)

Toxicology: Readily absorbed by all routes. Reported signs and symptoms: headache, nervousness, blurred vision, weakness, nausea, cramps, diarrhea, vomiting, chest discomfort, sweating, miosis, tearing, salivation, excessive secretions, cyanosis, papilledema, muscle twitching, convulsions, coma; illness somewhat more protracted than usual for this type of insecticide.

Clinical Chemistry: Marked inhibition of blood cholinesterase in severe cases.

Treatment: Atropine sulfate 1-2 mg i.m. Ii excessive secretions occur, atropine hourly to 25-50 mg in a day, Keep patient atropinized. Decontaminate skin, eyes, stomach (induce vomiting). 2-PAM*; slowly i.v. if patient fails to respond (1 g for adults, 0.25 g for infants). *In* severe cases: suction of trachea secretions and artificial respiration; oxygen; atropine 2-4 mg i.v. as soon as cyanosis has subsided; repeat at 5-10 minute intervals until signs of atropinization occur; 2-PAM* i.v. slowly. *Contraindicated* are morphine, theophylline, aminophylline; atropine in cyanotic patients: caution with tranquillizers,

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• pralidoxime, Protopam®, pyridine-2-aldoxime methochloride

Data Sheet No, 1.3

Organophosphate **NALED**

Identity: **1,2-dibromo-2,2-dichloroethyl dimethyl phosphate**

Formulations: **Mostly solutions for spraying**

Use Data: **Insecticide: control of flies and mosquitoes**

Toxicity: **Oral: II (moderately toxic)**
Dermal: II (moderately toxic)

Toxicology: **Readily absorbed by all routes. No cases of human poisoning reported. Signs and symptoms, most likely, not diffexent from those reported for other organophosphata insecticides such as diazinon or chlorpyrifos (see data sheets 1.2 and 1.4)**

Clinical Chemistry: **Marked inhibition of blood cholinesterase in severe cases**

Treatment: **Atropine 1-2 mg i.m. If excessive secretions occur, atropine hourly to 25-50 mg in a day. Keep patient atropinized. Decontaminate skin, eyes, stomach (induce vomiting). 2-PAM* slowly i.v. if patient fails to respond (1 g for adults, 0.25 g for infants). In severe cases; suction of trachea secretions and artificial respiration: oxygen; atropine 2-4 mg i.v. as soon as cyanosis has subsided; repeat at 5-10 minute intervals until signs of atropinization occur; 2-PAM* i.v. slowly.** *Contraindicated* **are morphine, barbiturates, phenothiazine tranq'uillizers and CNS stimulants of all kinds; atropine in cyanotic patient.**

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* **pralidoxime, Protopam®, pyridine-2-aldoxime methochloride**

Data Sheet No. 1.4

Organophosphate

CHLORPYRIFOS

Identity: 0,0-diethyl O-(3,5,6 trichloro-2-pyridyl) phosphorothioate

Formulations: Wettable powder, 25%; emulsifiable concentrates, 25-50%; 1-10% granules.

Use Data: Insecticide. Animal dip or spray, plant and tree spray, larvicide, and spray for mosquitoes, common household insects.

Toxicity: Oral: II (moderately toxic)
Dermal: II (moderately toxic)

Toxicology: Absorbed by all routes, especially by gastrointestinal tract. Reported signs and symptoms: excessive sweating, headache, weakness, giddiness, nausea, vomiting, stomach pains, blurred vision, slurred speech, muscle twitching, convulsions, coma.

Clinical Chemistry: Decreased blood cholinesterase, urinary levels of diethyl phosphate and phosphorothioate. Possibly unchanged chlorpyrifos in blood.

Treatment: Atropine sulfate 1-2 mg i.m. If excessive secretions occur, atropine hourly to 25-50 mg in a day. Keep patient atropinized. Decontaminate skin, eyes, stomach (induce vomiting). 2-PAM* i.v. slowly, if patient fails to respond (1 g for adults, 0.25 g for infants). In severe cases: suction of trachea secretions and artificial respiration; oxygen; atropine 2-4 mg i.v. as soon as cyanosis has subsided; repeat at 5-10 minute intervals until signs of atropinization occur; 2-PAM* i.v. slowly. *Contraindicated* are morphine, barbiturates, phenothiazine tranquillizers and CNS stimulants of all kinds; atropine in cyanotic patient.

---

* pralidoxime, Protopam®, pyridine-2-aldoxime methochloride

Data Sheet No. 1.5

Methylcarbamate PROPOXUR

Identity: 0-isopropoxyphenyl methylcarbamate

Formulations: Solutions, bait, and powders

Use Data: Insecticide; for control of flies, mosquitoes and cockroaches, and as a barrier for millipedes.

Toxicity: Oral: II (moderately toxic)
Dermal: II (moderately toxic)

Toxicozogy: Readily absorbed by all routes. Reported signs and symptoms: blurred vision, nausea, vomiting, sweating, high pulse rate and systolic blood pressure, muscle weakness; rapid development of symptoms, but large margin between minimal effective dose and lethality.

Clinical Chemistry: Rapid depression of red-blood-cell cholinesterase without change in plasma ChE activity; recovery rapid: propoxur excreted in urine.

Treatment: Induce vomiting or gastric lavage in case of ingestion; decontaminate skin and eyes; atropine *1-2* mg i.m. in case of severe poisoning. *Contraindicated* are oximes, barbiturates and central stimulants.

Methylcarbamate

Data Sheet No. 1.6
CARBARYL

Identity: **1-naphthylmethylcarbamate**

Formulations: **Sprayable powders and dusts; oil and water based liquid suspensions.**

Use Data: **Insecticide: preharvest treatment of many crops; also used on trees; also on domestic animals fox control of ticks, lice and fleas (e.g., as a 5 percent powder).**

Toxicity: **Oral: III (slightly toxic)**
Dermal: III (slightly toxic)

Toxicology: **Ingestion main-route of absorption; inhalation and skin absorption less efficient. Reported signs and symptoms: excessive sweating, headache, weakness, giddiness, nausea, vomiting, stomach pains, blurred vision, slurred speech, muscle twitching.**

Clinical Chemistry: **Cholinesterase depression only immediately after uptake of carbaryl; 1-naphthol in urine increased (normal 1.5-4 ppm; hazard level >10 ppm; symptomatic level >30 ppm).**

Treatment: **Gastric lavage using 5 percent sodium bicarbonate in case of ingestion of 1 g or *more;* skin: wash with soap and water: eyes: lavage with isotonic saline; atropine 1-2 mg i.m. in case of severe poisoning. *Contraindicated* are oximes, barbiturates and central stimulants.**

Data Sheet No. 2.1

Chlorinated hydrocarbon **CHLORDANE**

Identity: 1,2,4,5,6,7,8,8-octachloro-3a,4,7,7a-tetrahydro-4,7,-methanoindane

Formulations: Wettable powder, emulsifiable concentrates, oil solutions

Use Data: Insecticide. Approved only fox termite control*

Toxicity Oral: II (moderately toxic)
Dermal: II (moderately toxic)

Toxic0 logy : Readily absorbed by all routes. Reported signs and symptoms: CNS excitation, *convulsions* and coma may occur in as little as 30 minutes after ingestion.

Clinical Chemistry: Nonspecific and usually negative; chlordane or its derivatives may be recovered from stomach contents, urine, or tissues, especially fat.

Treatment: If ingested: syrup of ipecac, gastric lavage, saline laxatives. If skin exposure: soap and water. Sedation with phenobarbital or pentobarbital. Calcium gluconate to control convulsions. *Contraindicated:* epinephrine, oil laxatives.

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* In view of potential environmental accumulation of chlordane, USEPA instituted a ban on all marketing and use of this pesticide. Only a few specific uses (such as for termite control) will be retained.

Miscellaneous

Data Sheet No. 3.1
ANTICOAGULANTS

Identity: Anticoagulants as used in pesticide formulations are usually one, or a combination, of the following:
Warfarin (3-(α-acetonylbenzene) -4-hydroxycoumarin
Fumarin (3-(α-acetonylfurfuryl)-4-hydroxycoumarin
Diphacinone (2-diphenylacetyl-1,3-indandione)
Pival (2-pivalyl-1,3-indandione)

Formulations: Prepared baits with 0.005 to 0.025 percent of anticoagulant; solutions for preparing baits in concentrations of 0.05 to 0.3 percent of coagulant.

Use Data: Rodenticide; rat and mouse control.

Toxicity: All are I (highly toxic) in pure form; classification is of little value as available concentrations are extremely low.

ToxicoZogy: Absorption by ingestion. Large amounts of formulated preparation required, preferably taken repeatedly. All act by inhibiting formation of a number of clotting factors in liver, and increase the capillary fragility. Reported signs and symptoms: hemoptysis, hematuria, bloody stools, bleedings in organs and joints, widespread bruising; after chronic ingestion: also jaundice, hepatomegaly, agranulocytosis, renal damage, nausea, orange color of urine, fever.

Clinical Chemistry. Marked increase of prothrombin time, slight increase of clotting time; lowered RBC and hemoglobin.

Treatment: Induce vomiting if willful ingestion of rodenticide bait or solution is suspected; have stomach contents examined for coumarin and indandione derivatives; irrespective of. symptoms: vitamin K 65 mg t.i.d. first day (after taking blood for PTT and other diagnostic tests), continue with smaller doses until PTT normal; extensive blood loss: frequent small blood transfusions.

Data Sheet No. 3.2

Miscellaneous PYRETHRIN

identity: Mixed active ingredient6 as present in extracts of the pyrethrum flower; two types (pyrethrin I and II) with a complicated chemical structure.

Formulations: Dusts, sprays, emulsifiable concentrates; most formulation6 contain also a synergist, usually piperonyl butoxide.

Use Data: Insecticide; against a wide variety of insects, especially mosquitoes, flies, cockroaches, lice.

Toxicity: Pyrethrins Oral: III (slightly toxic)
Piperonyl butoxide Oral: IV (practically nontoxic)

Toxicology: Absorption mainly by ingestion or inhalation; skin absorption negligible. Reported signs and symptoms: contact dermatitis with vesicles, papules and intense pruritus most common; respiratory allergic manifestations in hay fever and asthma patients; intake of high amounts may result in excitation progressing to convulsions: anaphylactic reactions rare.

ClinicalChemistry: Eosinophilia in acute allergic reactions.

Treatment: Symptomatic

Data Sheet No. 3.3

Miscellaneous **2,4-D**

Identity: **2,4-dichlorophenoxyacetic acid**

Formulations: **Any salts, pastes, emulsifiable concentrates, wettable powders, 2-98 percent dusts.**

Use Data: **Herbicide; for selective weed control**

Toxicity: **Oral: II (moderately toxic); salts and esters III (slightly toxic)**
Dermal: II (moderately toxic)

Toxicology: **Main route of absorption: by mouth. Reported signs and symptoms: weakness and fall of blood pressure main manifestations after sublethal doses; severe cases may demonstrate burning pain in throat and abdomen, nausea, vomiting, skin rash, myotonia, fibrillary twitching, and hyporeflexia**

Clinical Chemistry: **LDH, SGOT, SGPT elevated if muscle damage has occurred; myoglobin and hemoglobin may be found in urine**

Treatment: **Remove skin contamination with soap and water; if ingested, give activated charcoal, induce vomiting; quinidine sulfate 200 mg i.m. eve. 4-6 hrs in case of cardiac or muscle irritability; replace electrocyte losses from vomiting if *severe;* symptomatic treatment of other signs and symptoms**

Miscellaneous

Data Sheet No. 3.4
BROMACIL

Identity: 5-bromo-3-sec-butyl-6-methyluracil

Formulations: Granules, powders, solutions and suspensions; sprayed or spread dry

Use Data: Herbicide; control of wide range of weeds

Toxicity: Oral: IV (practically nontoxic)
Dermal: IV (practically nontoxic)

Toxicology: No intoxications in humans have been reported concentrated solutions or suspensions may irritate the skin and mucosae

Clinical Chemistry: Unremarkable

Treatment: Symptomatic; decontamination of skin and eyes by washing if indicated